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try round Lake N'yassa. In the same number is an extended notice, by Keith Johnston, of the cartographical publications of the Indian Survey. These include, besides numerous maps of special districts, the "long-expected" General Map of India. A book relating to the discoveries of the fifteenth century has been published by Richard Henry Major, entitled *The Discoveries of Prince Henry the Navigator, and their Results*; being the Narrative of the Discovery by Sea, within One Century, of More than Half the World. This period includes the exploration of the coasts of Africa, the discovery of America and Australia, the circumnavigation of the globe, and the opening of a sea-way to India, the Moluccas, and China. J. W. Boddam Whetham, in a book entitled *Across Central America*, gives interesting notes of travel through a hitherto rarely visited region, with an account of some of the wonderful ruins of Central America.

MICROSCOPY.¹

E. GUNDLACH'S NEW PERISCOPIC EYE-PIECE.—The Hughenian eye-piece, as originally constructed, consists, as is well known, of two plano-convex lenses, of which one, the field-lens, has three times the focal length of the other, the eye-lens, the distance between the two being equal to double the focal length of the eye-lens, the plane side of the field-lens facing the convex side of the eye-lens.

The field-lens not only widens the field of view but also corrects the spherical as well as the chromatic aberration, as it is placed beyond the focal distance of the eye-lens (which is the actual eye-piece), and in consequence thereof acts negatively to the same.

This correction, however, is not a complete one, for with the most favorable distance between the two lenses a not inconsiderable remnant of the chromatic aberration still remains, while the spherical aberration is already correspondingly over-corrected. The first is noticeable by the blue edge bordering that side of the object which is turned toward the centre, when the object is placed towards the edge of the field; the remnant of the spherical aberration causes the distortion and want of sharpness of definition at the edge of the field. By increasing the distance between the field-lens and eye-lens the blue color may indeed be made to disappear, but the spherical aberration increases correspondingly, and the field is narrowed considerably. If, on the contrary, the field-lens is brought closer to the eye-lens, the spherical aberration is certainly diminished; but notwithstanding this, the image at the edge of the field does not become any more sharply defined, because the chromatic aberration has increased in equal ratio.

One advantage, however, is gained by approaching the field-lens closer to the eye-lens, namely, a considerable widening of the field.

If, under these circumstances, the aberrations of the eye-lens are cor-

¹ Conducted by DR. R. H. WARD, Troy, N. Y.

rected by suitably composing the same of flint and crown glass, we have an eye-piece which, with all the advantages of the Hughenian eye-piece, surpasses the latter by having a larger field.

These facts form the basis of the construction of the Kellner orthoscopic eye-pieces. Kellner brought the field-lens into the focus of the eye-lens, made the latter achromatic, and chose such curvatures as to remove the spherical aberration and show a flat field, for which latter purpose he also transformed the plano-convex field-lens into a double-convex one.

The simultaneous accomplishment of all these results was favored by the circumstance that in approaching in a Hughenian eye-piece the field-lens to the eye-lens the spherical aberration diminishes more rapidly than the chromatic. The preponderance of the latter over the former in the Hughenian eye-piece must therefore admit of being equalized at a certain point, or rather must accommodate itself at this point to a similar disproportion in the achromatic eye-lens. This point, however, is, as in the Kellner eye-piece, almost exactly the focus of the eye-lens.

A further approach of the field-lens to the eye-lens (bringing the latter within the focus of the former), again gives the preponderance to the chromatic aberration, and an equalization by an achromatic double lens becomes impossible under the circumstances.

If, however, such further approach should be possible without such or other disadvantages, it would be very desirable, not only on account of the enlargement of the field which it would cause, but also on account of the circumstance that when the field-lens is in the exact focus of the eye-lens every fine particle of dust on the former is clearly visible and sharply defined, greatly interfering with the observation.

These facts and considerations caused me to reflect whether a triple eye-lens (consisting of two positive crown-glass lenses and one negative flint-glass) instead of a double lens would not better answer the conditions, and I have in consequence succeeded in forming such a lens which answers the purpose in a very high degree.

My new "periscopic eye-piece" consists of a triple eye-lens, a double-convex field-lens, the latter being situated within the focal distance of the former, and a diaphragm located in the focus of the equivalents of both lenses.

The field of the new eye-piece is considerably larger and flatter than that of Kellner's, and the image is sharply defined to the extreme edge.

As the focus of this eye-piece lies behind the field-lens (the same as in Ramsden's eye-piece), it is particularly suitable for micrometers, especially as the division is distinctly and in correct proportion visible to the extreme edge, which is notably not the case with Ramsden's eye-piece.

A micrometer division placed in the focus of this eye-piece shows, moreover, very perspicuously the high degree of the correction of the aberrations, while the image transmitted by an objective can be no relia-

ble test, as the aberrations of the objective, particularly the distortion, are easily confounded with those of the eye-piece. — E. GUNDLACH.

OBJECTIVES AS ILLUMINATORS. — Mr. George W. Morehouse urges strongly the use of the best attainable objectives as substitutes for the various illuminating accessories furnished with microscopes, on the principle that the illuminator should exactly equal the magnifier in capacity in all respects, which he has not found true of any of the illuminators. By using immersion objectives of the highest angle, properly centred and focused, as achromatic condensers, he believes the truest appearance of the object is obtained, and with the least liability to errors of interpretation, the images of structure lying in different focal planes being separated with the greatest accuracy. Of course, the objects for this use must be mounted in balsam between two thin cover-glasses, or if mounted dry they must be in actual contact with both glasses.

He has also had more than ordinary success with the plan of making the objective its own illuminator for opaque objects, first successfully introduced by Prof. H. L. Smith. He uses the form known as Beck's vertical illuminator, which is a thin glass disk in an adapter above the objective, light from a flat-wicked lamp placed edgeways, at a distance of about eight inches, being reflected by the disk through the objective upon the object. The image of the flame should be seen in the centre of the field, where, with immersion objectives of the highest angle, details of surface structure can be seen with the greatest distinctness with powers as high as four thousand diameters. The projecting spines upon the test podura scales can be thus seen both on the surface and at the edge of the scales; and even objects that only imperfectly reflect the light, such as diatoms, can be distinguished with clearness and beauty. *Pleurosigma angulatum* is seen in hexagons, and *A. pellucida* shows the striæ sharply when the illumination is rendered one-sided by the hand or any other obstruction held partly between the flame and the reflecting disk.

MOUNTING IN DAMMAR. — The occasional failure of specimens mounted in dammar to keep well, by reason of the external ring of varnish running in, or other disaster due to imperfect hardening of the dammar, has led to an interesting and useful discussion in the pages of *Science Gossip*. The best method seems to be to place the object, previously soaked in turpentine or benzole, on the slide, and then either drop the dammar on the object and press down on it the slightly warmed cover-glass, or else place the object from the turpentine on the slide, cover it with the cover-glass, and allow the dammar to flow in assisted by a moderate warmth, — in either case the slide being at once transferred to a metal plate about six inches above the flame of a spirit lamp. As the heat should not be sufficient to boil the dammar, air bubbles will not form, and the progress of the drying need not be closely watched while attending to other work. In about an hour the dammar will be so hardened as to be quite safe, the precise time to remove it from the plate being determined by taking up

on the point of a pin a particle of the superfluous material which has collected at the edge of the cover, which should form, when cold, a globule perfectly hard and not at all sticky.

OPAQUE-GLASS SLIDES. — Mr. Carl Meinert contributes to the Postal Club a slide having an opaque object mounted on a slide of white porcelain-glass. Some years ago Rev. E. C. Bolles suggested a similar use of black glass for white objects. Both methods make very handsome slides, though for real usefulness we prefer the ordinary slides, as there is scarcely an object on which it might not at some time be desired to pass light through the glass, while a dark background can always be easily secured.

EXCHANGES. — Diatomaceous material containing triceratium wanted in exchange for mounted specimens. Address G. C. Morris, E. Tulpehocken St., Germantown, Philadelphia.

“Plumule” scales of small cabbage butterfly (*Pieris Rapæ*), mounted, for good slides. Address Edward Pennock, 805 Franklin St., Philadelphia.

SCIENTIFIC NEWS.

— As the close season for salmon commences August 1st and extends to November 1st, no more of these fishes will be on sale while they are spawning in our rivers. The law is very stringent against their sale during the season, and makes it a misdemeanor to catch, sell, or have them in possession. — *San Francisco paper*.

— Dispatches of July 2d state that plentiful rains have fallen lately in the famine-stricken districts of Northern China, and the crops are in a flourishing condition. Locusts have, however, appeared in some parts and committed great ravages.

— The Shepard Scientific Collections have recently been purchased by the authorities of Amherst College, at a cost of \$40,000, a sum about one half their appraised value. These collections are three in number, a geological, a mineralogical, and a meteoric. The mineralogical collection is one of rare beauty and value, while the meteoric ranks as the fourth in point of size and interest in the world. The college has thus secured some of the most important and valuable collections possessed by any university, either in this country or in Europe. These collections were taken to Amherst from New Haven in 1847, and although deposited by Professor Shepard in the college cabinets at Amherst have hitherto been the property of Professor Shepard.

— Dr. A. B. Meyer, director of the Royal Zoölogical Museum of Dresden, announces his intention to publish figures of rare bird-skeletons, hitherto not at all or insufficiently figured. The work will be issued in parts, containing ten plates each, at intervals of about three months. The price of each part will be fifteen shillings, and the edition limited.

— Messrs. A. O. Hume, C. H. T. and G. F. L. Marshall will shortly